Beta-Alanine Supplementation Augments Muscle Carnosine Content and Attenuates Fatigue in Trained Sprinters

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PURPOSE: Carnosine is present in high concentrations in skeletal muscle and is thought to contribute to homeostasis during contractions as a pH buffer and Ca⁺⁺ sensitizer. The ingestion of beta-alanine (β-alanine), the rate-limiting precursor amino acid of the dipeptide carnosine (β-alanyl-L-histidine), has been shown to elevate muscle carnosine content in trained and untrained subjects. The present study aimed to investigate, using proton NMR, whether oral supplementation of β-alanine during 4 weeks could elevate the calf muscle carnosine content in 400 m sprint-trained competitive athletes, and secondly if supplementation had an effect on indoor 400 m indoor running performance, and on isokinetic and isometric muscle performance and fatigue. METHODS: 15 men track-and-field athletes with a personal 400 m record below 52 s were recruited from Flemish athletics clubs. A placebo-controlled, double-blind study was performed. Subjects were supplemented orally for 4 weeks with 4.8 g/day placebo (maltodextrin) or β-alanine. Muscle carnosine concentration was determined by the C2-H imidazole peak of the proton NMR spectrum in a single voxel in the soleus and gastrocnemius. The time to complete 400 m running was evaluated in an indoor 300 m flat athletics track. Subjects also performed an isokinetic test consisting of 5 bouts of 30 maximal voluntary knee extensions on a Biodex isokinetic dynamometer. Additionally, subjects were asked to contract isometrically with their knee extensors at a target force of 45% of MVC for as long as possible to determine the isometric endurance time. RESULTS: The muscle carnosine content of the soleus increased by 47% (p < 0.001) in the β-alanine group, whereas it remained stable in the placebo group. The increase in carnosine in the gastrocnemius was significantly more pronounced in the β-alanine group (+37%) than in the placebo group (+16%). A significant pre/post positive effect was observed for the average peak torque in the placebo group for the first two bouts of the isokinetic test, but not for the subsequent three bouts. Whereas for the β-alanine group there was a significant pre/post main effect, indicating that average torque was higher post-supplementation in all five bouts. The knee extensor isometric endurance and the 400 m race time were not affected by treatment. CONCLUSION: In conclusion 1) proton NMR spectroscopy can be used to noninvasively quantify human muscle carnosine content; 2) muscle carnosine content can be substantially elevated by oral β-alanine supplementation in sprint-trained athletes; 3) muscle carnosine elevation significantly attenuated fatigue in repeated bouts of exhaustive dynamic contractions; 4) the 40–50% increase in muscle carnosine did not improve isometric endurance or 400 m running. PRACTICAL APPLICATION: Noninvasive measurement of muscle carnosine will greatly assist in future studies exploring the potential of β-alanine as an ergogenic aid.

Neuromuscular and Endocrine Response to Three Volume Equated Resistance Exercise Protocols

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PURPOSE: To examine neuromuscular fatigue and acute hormone response to three lower body resistance exercise (RE) protocols equated for total volume. METHODS: Ten subjects experienced in RE completed a one repetition maximum (1RM) in the back squat and performed three different RE protocols on three separate days using a randomized cross-over design. The RE protocols included 1) hypertrophy (H): 4 sets of 10 repetitions in the squat at 75% of 1RM (90 seconds rest periods); 2) strength (S): 11 sets of 3 reps at 90% of 1RM (5 minute rest periods); 3) power (P): 8 sets of 6 repetitions in jump squats 0% of 1RM (3 minute rest periods) and 4) control day with no exercise (R). One week was allowed between each treatment (H, S, P, and R). The three RE protocols were equated for total work (force × displacement) and load, but were designed to elicit the mean eccentric and concentric load and power for each repetition of each protocol. Blood draws were taken at rest (PRE), immediately post (IP), 60 minutes post (60P), 24 hours (24P), and 48 hours (48P) following the completion of each protocol. Enzyme linked immunoassay (ELISA) were performed to determine the serum concentration of total testosterone (T), cortisol (C), and steroid hormone binding protein (SHBG) at each time point. Whole blood lactate samples were drawn and assessed to determine the metabolic demand at PRE, IP and at 60P. Peak force, rate of force development (RFD) and muscle activity from the vastus medialis (VM) and biceps femoris (BF) were measured during a maximal isometric squat test at PRE, IP, 60P, 24P and 48P as well. RESULTS: Whole blood lactate concentrations at IP were significantly elevated following H in comparison to S and P (H = 13.0 mmol/L, S = 7.1 mmol/L, P = 2.7 mmol/L and R = 2.0 mmol/L). The percent change from PRE to IP was significantly greater following H in comparison to the R condition for T (H = 32.3%, R = 3.4%), C (H = 12.4%, R = 35.9%), and SHBG (H = 29.1, R = 5.2%). No differences in hormone concentrations existed between the any of the groups at 24P and 48P. The H and S protocols elicited a significant percentage decrease in peak force (H = 25.5%, S = 16.4%) and RFD (H = 29.2%, S = 25.7%) at IP. The S protocol also resulted in a significant percentage decrease in RFD at 24P (S = 13.4%). Muscle activity of the VM at IP during H was significantly greater than that of the S protocol. CONCLUSION: These data indicate the neuromuscular and hormonal responses are specific to RE intensity and rest period and are independent of volume. PRACTICAL APPLICATION: RE protocols should be utilized according to the desired physiological response specific to the intensity and rest period prescribed.
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Relationships Between Strength, Power, and Walking Performances in Elderly

INTRODUCTION: The ability of walking is an important component of personal mobility for elderly people. Previous reports indicated that leg weakness has been identified as an important risk factor of falls, and functional tasks, such as walking speed, balance, and sit-to-stand performance have also been related to fall risk. Elderly people might be confronted with some obstacles in their daily activity, such as a stone on the street, gap or depression in the ground. The purpose of this study was to investigate the relationships between muscular function and simulated walking task in elderly. METHODS: Forty-five elderly subjects, from 60 to 76 years, volunteered for this study (66.3 ± 4.6 year, 157.3 ± 7.5 cm, 55.9 ± 9.5 kg). Walking and physical performances following the medical screening were completed by sixteen males and twenty-seven female subjects. Walking time was measured at four different tasks, 1) normal speed (WN), 2) maximum speed (WM), 3) hurdle (WH), 4) balance (WB) using a straight 10 m lane in the gym. Their normal form of walking was performed during WN and WM with designed speed. Subjects stride over a hurdle (height; 0.3m) placed at mid point of 10 m walking in WH. WB was included that subjects walk on the two 3 m wooden board (width; 10 cm, thickness; 3 cm) placed on the floor. As a strength and power performance of the leg, vertical jump (VJ), leg press power (LPP), sit-to-stand test (STS), and several isometric strength were measured. Isometric strength test consisted of knee extension (KE), knee flexion (KF), plantar flexion (PF), dorsiflexion (DF), and hip flexion (HF). MRI and Ultrasound technique were utilized to evaluate the cross sectional area of psoas major muscle or muscle thickness of the leg. RESULTS & DISCUSSION: The duration of 10 m walking tasks were 6.78 ± 1.01 second (WN), 5.90 ± 0.60 second (WM), 5.50 ± 0.64 second (WH) and 5.77 ± 1.14 second (WB), respectively (Mean ± SD). Strength and power parameters showed specific features that ST, VJ and LPP have correlated to the strength except DF (p < 0.05–0.001) were observed all isometric strength values and WM or WH. WB also correlated to the strength except DF (p < 0.05–0.01). WN and WH had no significant correlation to muscle thickness and CSA. The psoas major CSA was correlated to the WM (p < 0.05). Muscle thickness in the forepart of lower leg also correlated to the WB (p < 0.05). From these results, it was suggested that basic strength and power of the hip and legs were important to various situation of walking. Multi-joint strength and power test were related to intense walking tasks. Single joint strength of the hip and leg has also correlated to specialized walking. PRACTICAL APPLICATION: There are many fall risks around living area for elderly, such as a stair of the house, a difference in level of the street, gap and depression in the ground etc. Basically, to decrease the risk factor of fall, it was important that to improve the strength produced by the joint in hip and leg. In addition, strengthening muscle function and performances with multi-joint task might help further activities in elderly.

Charactersitics of Leg Reactive Strength on Recreational Distance Runner

PURPOSE: Previous research has suggested that plyometric training improve running economy in highly trained long distance runners (Saunders 2006). Plyometric training may increase muscle stiffness and may reduce time of the stretch-shortening cycle, and may improve running economy in long distance running. Plyometric training generally improves explosive power that frequently is assessed by leg reactive strength (LRS). The purpose of this study was to investigate the characteristics of the LRS on recreational distance runners, and compare the LRS of recreational distance runners and collegiate distance runners. METHODS: Healthy recreational distance runners and well-trained collegiate distance runners participated in this investigation. Participants were divided into recreational male distance runner's group (RM; n = 19, 48.9 ± 9.1 years, 168.0 ± 7.0 cm, 60.8 ± 7.1 kg), recreational female distance runner's group (RF; n = 17, 40.1 ± 6.1 years, 157.8 ± 4.8 cm, 49.0 ± 5.2 kg), collegiate male distance runner's group (CM; n = 13, 20.9 ± 1.5 years, 171.3 ± 3.8 cm, 59.7 ± 4.5 kg), collegiate female distance runner's group (CF; n = 12, 18.7 ± 0.7 years, 158.8 ± 5.9 cm, 47.0 ± 4.5 kg).

The LRS was assessed by a countermovement-jump test using FITRO jumper (Slovakia). The LRS was calculated using the formula (LRS = g/2Ta²/Tc), where g is 9.81 m/s², and Ta and Tc are air time and contact time, respectively. Compared with the LRS among four group (RM, RF, CM, CF), were analyzed using a one factor ANOVA. In the event of a significant F ratio, multiple comparison test (Tukey test) was employed. RESULTS: The LRS of RM, RF, CM, and CF were 118.5 ± 27.2, 211.1 ± 24.3, 223.6 ± 31.7, 147.6 ± 24.2, respectively. The Tu (sec) of RF, CM, and CF were. 0.177 ± 0.028, 0.175 ± 0.023, 0.157 ± 0.014, 0.179 ± 0.016, respectively. The Jump height (JH; cm) of RM, RF, CM, and CF were 21.6 ± 3.8, 21.4 ± 3.6, 35.0 ± 3.6, 26.2 ± 3.5, respectively. The result of multiple comparison of the LRS among four group were as follows; CM < CF < RM, RF. Multiple comparison of the JH were as follows; CM < CF < RM, RF. However, No significant differences of the Tu among four groups were observed. CONCLUSION AND PRACTICAL APPLICATION: These results show that recreational distance runners were significant lower than collegiate distance runners in the LRS. The difference of the LRS between recreational distance runners and collegiate distance runners may be influenced by the difference of jump height. Further work will be needed to address about explosive power in recreational distance runners and collegiate distance runners.

Validity of Laboratory and Field Methods for Estimating Percent Body Fat in College Female Athletes: A Multiple Component Approach

PURPOSE: The purpose of the present study was to determine the validity of laboratory and field methods for estimating percent body fat (%BF) in college female athletes. METHODS: Thirty Caucasian female Division I collegiate athletes (19.8 ± 1.4 years) volunteered to have their %BF estimated by laboratory (hydrostatic weighing (HW), air displacement plethysmography (ADP), and dual-energy X-ray absorptiometry (DEXA)) and field methods (bio-electrical impedance analysis (BIA), bioimpedance spectroscopy (BIS), near-infrared interactance (NIR) and the three- and seven-site generalized and population-specific skinfold equations of Jackson and Pollock (JP3, JP7) and Evans et al. (E3 and E7, respectively). Three (3C) and four-component (4C) model %BF estimations included bone mineral content from DEXA and body density values from HW with the addition of total body water derived from BIS in the 4C model. Constant error (CE), validity coefficient (r), standard error of estimate (SEE), and total error (TE) were used to compare the estimated %BF values from laboratory and field methods to both the 3C and 4C models. RESULTS: Compared to the 3C model, CE values ranged from 0.39%BF (ADP) to 4.50%BF (DEXA), r values ranged from 0.65 (BIS) to 0.97 (HW), SEE values ranged from 1.35%BF (HW) to 4.50%BF (BIS), and TE values ranged from 1.84%BF (HW) to 5.24%BF (DEXA) with significant CE’s from NIR, BIA, HW and DEXA (p < 0.005). Compared to the 4C model, CE values ranged from 0.36%BF (E3) to 4.24%BF (DEXA), r values ranged from 0.75 (BIA) to 0.94 (BIADP), SEE values ranged from 1.94%BF (BIA) to 3.35%BF (JP7), and TE values ranged from 2.30%BF (BIS) to 5.54%BF (DEXA) with significant CE’s from NIR, BIA, JP7, HW, and DEXA (p < 0.005). CONCLUSION: Of the field methods, NIR (TE = 4.33%BF), BIS (TE = 4.83%BF), and BIA (TE = 4.82%BF) produced unacceptable TE values (<4.0%BF) while the DEXA (TE = 5.24%BF) was the only laboratory method to produce unacceptable TE values when compared to the 3C model. Compared to the 4C model, the NIR (NIR = 4.32%BF) was the only field method to yield an unacceptable TE while the DEXA (TE = 5.54%BF) was the only laboratory method that produced an unacceptable TE. Of the field and laboratory methods, the NIR and DEXA produced the only unacceptable TE values, compared to both the 3C and 4C models, and should not be used to estimate the %BF of college female athletes. In summary, all four skinfold equations, ADP, and HW had acceptable TE values (<4.0%BF) compared to both the 3C and 4C models and are recommended to estimate %BF in this population. PRACTICAL APPLICATION: In accordance with the results in this study, HW and ADP may be the preferred laboratory methods for measuring %BF in female collegiate athletes. Access to laboratory methods, however, may be limited to most athletes; therefore, valid field methods may be more appropriate. In the present study, the generalized (JP3, JP7) and population-specific (E3, E7) skinfold equations resulted in the lowest TE values compared to both the 3C and 4C models, and, therefore, are recommended as the preferred field method for estimating %BF in female collegiate athletes. Caution should be used when relying on the DEXA and NIR as valid laboratory and field methods to estimate %BF in collegiate Caucasian female athletes.